

History of esophageal surgery

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The history of medicine is inextricably linked to the evolution of human society since the dawn of civilisation up to the present times. It is also in a close relationship with the evolution of understanding human physiology and anatomy, as well as with technological progress, in general [1]. Naturally, the history of surgery, and particularly esophageal surgery, could not be an exception to that rule.

The greatest technical conundrums of the surgical approach of the esophagus pertained to the fact that it is the only organ in the human body which traverses three distinct anatomical regions (cervical, thoracic and abdominal, respectively). Moreover, it is situated in a very profound topographical region, especially in the posterior mediastinum, where it is in the vicinity of multiple vital structures [2].

The apparently insurmountable difficulties the pioneers of esophageal history faced were vividly described by R.G. EMSLIE (1988): "The history of esophageal surgery is a tale of men repeatedly losing to a stronger adversary yet persisting in this unequal struggle until the nature of the problems became apparent and the war was won." [3].

Although we cannot precisely ascertain a specific event which marked the birth of thoracic (and more particularly, esophageal) surgery, one of the oldest proofs in this direction was discovered in 1862 by Edwin Smith in Egypt. The papyrus Smith discovered, which has henceforth borne his name, was approximately dated between 2500–3000 BC and was only translated and edited in 1930 by Henry Breasted [4]. Case number 28 of this document describes a profound neck wound which had penetrated in the cervical,

which apparently was treated successfully (fig. 1).



Figure 1. Edwin Smith Surgical Papyrus. 1st Textbook of Surgery

The first known clinical description of esophageal cancer dates more than 2000 years ago and is included in a Chinese traditional medicine text. This text mentions 'swallowing problems' (dysphagia and regurgitation) in a certain patient. [5]. The renowned Greek

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physician Galen of Pergamon (c. 131 – c. 200 AD) reported on the signs of a mass of ‘meaty’ consistency obstructing the esophagus. The famous Persian physician Avicenna (Abu Ali Sina), who was born on the territory of present-day Uzbekistan, and practiced at the court of Harun al-Rashid in Bagdad, wrote in his well-known Canon of Medicine around 1025 AD that the most important symptom of esophageal tumors is dysphagia [2, 5]. J. L. COLLIS cited a commentary by the notorious military surgeon Ambroise Paré (1510–1590): ‘when the esophagus is sutured, a long postoperative tending period is to be expected’. His prediction would prove starkly correct in the following centuries [6].

WILLIS (1674) treated achalasia-associated dysphagia with dilatations using whale bones. For approximately 2000 years, the various treatments for esophageal diseases were strictly symptomatic [7].

The first reports of a gastrostomy feeding device used to treat dysphagia due to esophageal tumours were only reported in 1846 by Welsh and subsequently in 1849 by Sedillo [8].

The first experimental esophageal resection was performed in 1871 in Vienna by Theodor Billroth (fig. 2), in a canine model, as well as on human cadavers [5].

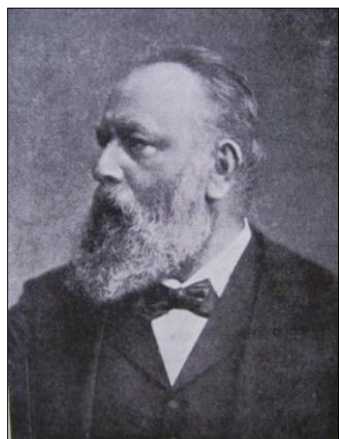


Figure 2. Theodor Billroth

One of Theodor Billroth's disciples, Vincenz Czerny, was the first surgeon to perform a successful resection of a cancerous cervical

esophagus. He repaired the visceral defect using a cutaneous tube fashioned from cervical skin [5, 8]. Johann von Mikulicz Radecki (acknowledged by Olch, in 1960, as the father of modern endoscopy) and Joseph Lister built the first endoscope with a distal light source. This novel technological improvement occurred after the discovery of the light bulb by Edison and the Vienna Electrical Exhibition in 1883) [2]. It was also von Mikulicz, who lived in Breslau, Germany (present-day Wroclaw, Poland), and was the mentor of Ferdinand Sauerbruch, in turn considered to be the father of modern thoracic surgery, who likewise Czerny performed a resection of cervical esophageal cancer. He repaired the esophageal defect with a skin tube plasty [5, 8].

Historically, the main problem of thoracic esophageal resection consisted of achieving respiratory control during a thoracotomy. In 1904, von Mikulicz introduced a system of differential pressure in order to control breathing-associated motion during the surgical intervention [9]. His disciple, Ferdinand Sauerbruch, was tasked with creating a differential negative pressure chamber, with a complicated outlay. This room was meant to contain both the operating team and the patient's body, leaving the patient's head out of the chamber for anaesthesiology reasons. However, positive pressure ventilation via endotracheal tube (Fell - O'Dwyer, 1893), the most important concept related to assisting respiration, had yet to be fully recognised [8].

As early as the beginning of the 20th century, Chevalier Jackson described the technique of direct laryngoscopy, while Meltzer and Auer, introduced laryngeal insufflation. However, it is not until 1930 that Gale, Waters, and Magill introduce and promote the direct visualisation method [8]. Once the technique of selective pulmonary intubation was developed, surgeons started benefitting from adequate intraoperative comfort.

A medical history of esophageal diverticula. Both esophageal diverticula and achalasia are considered motility disorders of the esophagus. The pharyngo-esophageal pulsion diverticulum was first described in 1767 by Abraham Ludlow from Bristol, UK in his work

„A case of obstructed deglutition from a preternatural dilatation of, and bag formed in the Pharynx” [7, 9].

In 1877, Friedrich Albert von Zenker and von Ziemssen (fig. 3) were the first to describe the etiology, physiopathology and symptomatology of the henceforth-called ‘Zenker’s diverticula’. Interestingly, they pleaded for a non-surgical therapeutic approach [7, 9].

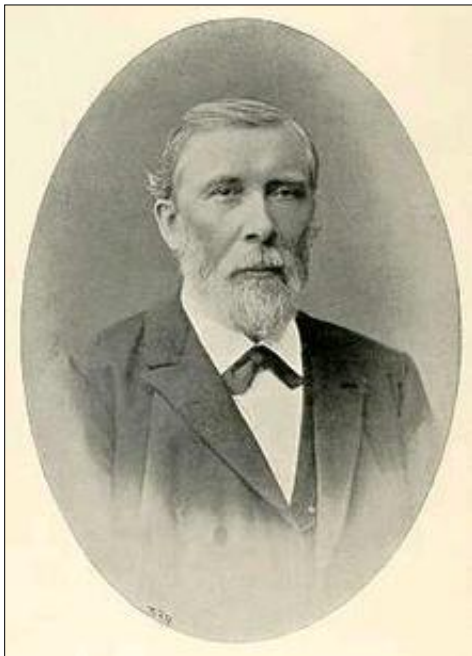


Figure 3. Friedrich Albert von Zenker

The first successful esophageal resection was performed in New York in 1913 by Franz Törek (fig. 4). The henceforth homonymous operation was done in a 67-year-old female patient for a malignant tumour of the middle third of the esophagus, and consisted of a subtotal esophagectomy with cervical esophagostomy and feeding gastrostomy. The anaesthesia for this operation was administered by dr. Carl Eggers, who subsequently pursued a successful career in thoracic surgery (fig. 5) [5, 8, 9]. The patient refused a reconstruction involving a prethoracic cutaneous tube. Therefore, for the following 13 years she was fed via a rubber tube which connected the cervical esophagostomy with the gastrostomy tube (fig. 6). She died at 80-years old due to causes unconnected to esophageal cancer.

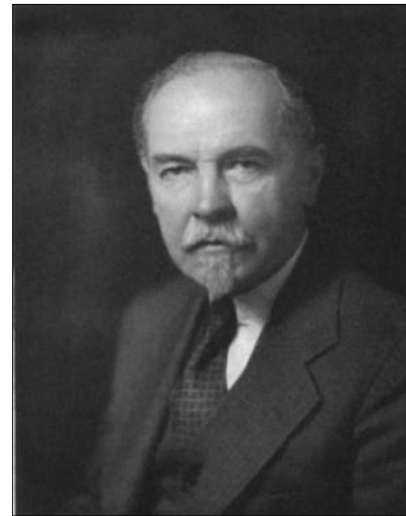


Figure 4. Franz Törek



Figure 5. Carl Eggers



Figure 6. The patient of Doctor Törek

Subsequent FRANZ TÖREK's presentation at the American Medical Association in 1913 regarding the first successful subtotal esophagectomy, his paper was poorly received and didn't start any discussions. Although the first society (Society of Thoracic Surgery) was created in the USA in 1967, the concern for esophageal surgery was minor, DONALD PAULSON lamenting the poor experience of residents regarding this matter (only 6 to 9 cases operated annually reported by the American Board of Thoracic Surgery) (7).

Esophageal reconstruction using the stomach. In 1905, Carl Beck (fig. 7) and Alexis Carrel (fig. 8) from Chicago have demonstrated in an animal model that a gastric antiperistaltic tube fashioned from the greater curvature of the stomach and placed presternally could potentially replace the inferior portion of the esophagus. Noteworthy, the graft was prolonged upwards to the cervical region with a cutaneous tube, by Bircher's technique [5, 8]. In 1906, Ion (Iancu) Jianu (fig. 9) performed in Romania an esophagoplasty using a cutaneous tube placed presternally.



Figure 7. Carl Beck



Figure 8. Alexis Carrel



Figure 9. Ion (Iancu) Jianu

In 1912, prof. Amza Jianu (Romania), was the first surgeon to attempt replacing the esophagus with an isoperistaltic gastric tube fashioned from the greater curvature of the stomach. He also interposed a cutaneous tube at cervical level in order to complete the plasty [5, 11].

In 1951, in Romania, Dan Gavrilu modified Amza Jianu's method, by combining the original operation with a splenectomy and a dissection of the tail and body of the pancreas medially to a plane situated to the right of the aorta. The rationale for this was facilitating the presternally-placed graft to reach the cervical region without the interposition of a cutaneous tube, as the latter would often cause multiple fistulas [11]. The artery feeding the graft was the splenic artery via the left gastroepiploic artery. Moreover, Gavrilu takes a step further and introduces an improved method (Gavrilu II), which consisted of fashioning the isoperistaltic tube from the whole antral region, the pylorus and the first part of the duodenum. A gastroduodenal anastomosis was therefore performed and the graft was consequently able to reach the pharynx at ease.

In 1988, Gavrilu accumulated the largest experience with this procedure worldwide, having operated 718 patients. The chapter describing his work, „The replacement of the esophagus by a gastric tube” was published in Jamieson GG Surgery of the Esophagus, by Churchill Livingstone. Boerema used a similar approach in the Netherlands. Heimlich (1961), who promoted this technique in the United States, started a polemic with Gavrilu, each of whom claimed to have invented the technique. It is important to point out that Heimlich had been a fellow in the Surgery Department of the „Carol Davila” Hospital in Bucharest, which was headed by Professor Gavrilu [9].

In regards to the techniques which utilise the whole isoperistaltic stomach, it is worth mentioning Martin Kirschner's (1928), which, similar to Nakayama's technique, preserved the right gastroepiploic artery as a feeding artery as well as the presternally-placed graft. As previously mentioned, Akiyama used the stomach (with a resected lesser curvature) in order to reconstruct the lower or the entire esophagus (Adams and Phemister, Garlock-Sweet, Ivor Lewis) [8].

Techniques of esophageal reconstruction using the jejunum. In 1907, Cesar Roux working in Lausanne attempted

reconstructing the distal esophagus with a Roux-en-Y loop of the jejunum. Unfortunately, the loop was not long enough to reach the cervical level, which is why a cutaneous tube had to be interposed. Herzen improved the method by introducing a three-step procedure. He utilised a jejunal loop excluded from digestive transit, thus gaining a few centimetres in length at mobilisation. A combination between this operation and the Bircher operation, which basically results in a jejunodermoplasty, was popularised by Lexer. The widest experience in terms of utilising jejunal loops for esophageal reconstruction was attained by S. Yudin, from the „Sclifossoski” Institute in Moscow (1944). He employed a host of technical improvements which allowed him to achieve a sufficient length of the jejunal graft. Nevertheless, if for any reason the length of the graft is unsatisfactory, the anastomosis was performed intrathoracically, assuming all the associated risks [8, 9, 11].

Techniques of esophageal reconstruction using the colon. The first attempts to utilise the colon in reconstructing the esophagus appeared at the same time as the first operations using the stomach. In 1911, Kelling and Vulliet used the colon in order to reconstruct the esophagus, independently from one another. Kelling performed a presteral by-pass with left isoperistaltic colon in order to reconstruct the esophagus after a resection for malignant tumour. Unfortunately, the patient died before the second step of the operation, i.e. the cervical anastomosis. Vulliet proved in a cadaveric model the feasibility of using the right colon in an anisoperistaltic manner in order to reconstruct the esophagus [5, 8].

Posttraumatic or congenital transdiaphragmatic hernias were described as early as the 16th century by Ambroise Paré (1579), Rivierus Lazari (1689), Giovanni Batista Morgagni (hernias through the foramen of Morgagni) and Vincent Alexander Bochdalek (congenital diaphragmatic hernias due to congenital diaphragmatic hernias due to non-closure of the Bochdalek hiatus) [12].

In 1926, Norwegian radiologist Ake Akerlund, practising in Stockholm, coined the

term 'hiatal hernia'(HH) in order to distinguish this clinical entity from other types of transdiaphragmatic hernias. He also introduced the first classification of HH:

- H-H due to brachyoesophagus, usually congenital;
- Paraesophageal H-H
- HH which cannot be included in the two aforementioned categories (axial HH) [1].

This classification was based on anatomical and radiological criteria. In the same year, Robins and Jankelson proved that radiologically-visible GERD are associated with epigastric pain and pyrosis in 90% of patients with HH. Moore and Kirklin introduced a radiological protocol for diagnosing HH. In 1932, Ferdinand Sauerbruch published a case series of radiologically evident HH with no clinical manifestations [12].

In hiatal hernia surgery and gastro-oesophageal reflux disease, there were two essential stages in the surgical conception:

- the anatomical stage in which the SEI function was not known and the operations were exclusively addressed to the extrinsic restraint mechanisms (Alisson operation via the thoracic approach and Lortat-Jacob via the abdominal route)
- the stage of anatomical and physiological concepts after the discovery of the lower esophageal sphincter by Fyke and Code [13].

Rudolf Nissen (fig. 10) (1896–1981), born in Germany as the son of a Prussian doctor, started his career in Munich in the clinic of Professor F. Sauerbruch. He was involved in operating patients with pulmonary tuberculosis and was the first surgeon to successfully perform a pneumonectomy. This was achieved in 1923, 2 years before Evarts Graham managed to perform one as well, in the United States [23]. In 1933, due to Nazi persecution, he was forced to leave Germany, taking up a leading role in Istanbul, Turkey. He subsequently relocated to New York, however he returned to Europe in 1952 as Chair of the Department of Surgery of the University Hospital in Basel, Switzerland. He remained in that position until 1967. In 1956, he

revolutionised the antireflux technique by proposing a 360°gastric fundoplication around the esophagus. This novel technique had its roots in an operation he performed in 1936. At that time, he operated a 28 year-old woman who had an esophageal ulcer penetrating in the pericardium. He performed a transpleural resection of the distal esophagus, cardia and an upper polar gastrectomy with an eso-gastric anastomosis. In order to prevent an intrathoracic anastomotic leak, he performed an invagination of the anastomosis in the stomach and plicated the gastric wall over the anastomosis in a Witzel gastrostomy-like fashion. He dubbed this procedure a 'continent esogastric anastomosis' and he noted that postoperatively there was no reflux symptomatology associated with the anastomosis [14].



Figure 10. Rudolf Nissen

Disclosure: authors have nothing to disclose

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